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ABSTRACT

Information is provided on current metric practices accepted by the Standards Council of Canada. Rules and examples are given for using units, symbols, and numerals. A table of metric prefixes; a list of units, prefixes and symbols; and a summary of commonly used units are provided. Interrelationships among units are noted. Information on numerical dating and a 24-hour timekeeping system is also provided. (MNS)

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METRIC
PRACTICE GUIDE

for

TEACHERS

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BASED ON ACCEPTED CANADIAN STANDARDS

This document is published solely as information providing current metric practices as accepted by the Standards Council of Canada.

PREPARED FOR DISTRIBUTION TO
ALBERTA SCHOOLS IN CO-OPERATION WITH
ALBERTA GOVERNMENT SERVICES, METRIC BRANCH
AND
ALBERTA EDUCATION

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USING UNITS

1. Unit names are spelled out in lower-case letters.

   e.g. litre newton kilogram

   Exception - degree Celsius

2. Only one prefix is used with a unit at one time.

   e.g. centilitre decimetre

3. If a compound unit involving division is spelled out, the word "per" is used.

   e.g. metres per second revolutions per minute

4. If a compound unit involving multiplication is spelled out, no hyphen is used.

   e.g. kilowatt hour

5. The choice of the appropriate decimal multiple or sub-multiple of a unit is governed by convenience. However, the use of prefixes representing 10 raised to a power that is a multiple of 3 is recommended.

   e.g. 0.6 km ($m \times 10^3$) rather than 6 hm ($m \times 10^2$)

USING SYMBOLS

1. The symbols are always printed in upright type.

   e.g. m g °C L

2. Symbols are written in lower case letters, except when the unit name is derived from a proper name.

   e.g. m s N Pa

   Exception - L (litre) The symbol ℓ is not acceptable.

3. When the names of units which derive from a proper name are written out in full, only Celsius is capitalized.

   e.g. newton pascal

4. Symbols should be used with numerals.

   e.g. 7 cm seven centimetres

5. Symbols are never pluralized.

6. A symbol is not followed by a period (except at the end of a sentence).

7. Symbols for prefixes are shown in lower case except for those that are greater than "kilo".

   e.g. kW (kilowatt) MW (megawatt)

8. Exponents are used with symbols for units that are squared or cubed.

   e.g. m^2 cm^3

9. Symbols should not be used to start a sentence.

10. Compound symbols formed by dividing units contain a solidus (/) to indicate the division.

    e.g. km/h (kilometres per hour) r/min (revolutions per minute)

11. The solidus, as a symbol of division, must not be repeated in the same expression unless ambiguity is removed by the use of brackets.

    e.g. (m/s)/s is acceptable
    m/s^2 is preferable

12. Division by a unit may be shown by means of a negative exponent. In such cases the dot must also be used to avoid misunderstanding.

    e.g. $m \cdot s^{-1}$ (metre per second)

13. When a unit is formed by division, the prefix, if any, should be attached to a unit in the numerator.

    e.g. km/s <u>not</u> m/ms

    <u>Exception</u> - When the base unit "kilogram" appears in the denominator.

    e.g. MJ/kg is perferred to kJ/g.

14. Compound symbols formed by multiplying units contain a dot to indicate multiplication.

    e.g. kW·h (kilowatt hour) N·m (newton metre)

USING NUMERALS

1. A space is left between the last digit of a numeral and the first letter of the symbol.

   e.g. 45 g 60 MW

   <u>Exception</u> - When the first character of a symbol is not a letter, no space is left.

   e.g. 15°C 30°20'40" (30.344° is the method used with computers and in compilation)

2. A decimal fraction is indicated by means of a decimal marker on the line, and at present, in Canada, the marker is generally a point positioned in line with the base of the associated numeral.

3. Spaces, not commas, are left between groups of 3 digits to the left and right of the decmal marker.

   Note: The space is optional if there are only 4 digits to the left or right of the decimal, unless such numerals are listed in a column with other numerals of 5 digits or more.

   e.g. 12 345.678 901 2
   1245 (1 245 optional)
   5.1234 (5.123 4 optional) but 5.123 45

   Exception - These guidelines do not apply to monetary units used on negotiable instruments. To help avoid fraud (filling in the space with a numeral), negotiable instruments will continue to use a comma. Students should recognize both forms of writing numerals.

4. Decimal fractions are generally preferred to common fractions.

5. A zero is placed to the left of the decimal marker if there is no other digit to the left.

   e.g. 0.25

6. In general, only one unit should be used to express a measured quantity.

   e.g. 1.15 m is preferred to 1 m 15 cm

7. In general, in the expression of any quantity, a prefix should be chosen so that the numerical value lies between 0.1 and 1000. However, when similar quantities are compared, it is better to use the same prefix for all items even though some values may fall outside the 0.1 to 1000 range.

8. A dot must not be used as a multiplier between numerals.

   e.g. 5x7 not 5·7

9. In the expression of numbers over ten, digits are preferred to fully spelled out words.

   e.g. 28 m

TABLE OF SI PREFIXES*

Multiplying Factor	Prefix	Symbol
1 000 000 000 000 000 000 = 10^{18}	exa	E
1 000 000 000 000 000 = 10^{15}	peta	P
1 000 000 000 000 = 10^{12}	tera	T
1 000 000 000 = 10^{9}	giga	G
1 000 000 = 10^{6}	mega	M
1 000 = 10^{3}	kilo	k
100 = 10^{2}	hecto	h
10 = 10^{1}	deca	da
0.1 = 10^{-1}	deci	d
0.01 = 10^{-2}	centi	c
0.001 = 10^{-3}	milli	m
0.000 001 = 10^{-6}	micro	μ
0.000 000 001 = 10^{-9}	nano	n
0.000 000 000 001 = 10^{-12}	pico	p
0.000 000 000 000 001 = 10^{-15}	femto	f
0.000 000 000 000 000 001 = 10^{-18}	atto	a

* Canadian Metric Practice Guide
National Standard of Canada
CAN 3-Z234.1-79
Canadian Standards Association

UNITS, PREFIXES AND SYMBOLS

Name of Unit or Prefix	Symbol	Quantity	Practical Equivalent
ampere	A	electric current	base unit
ampere per metre	A/m	magnetic field strength	
candela	cd	luminous intensity	base unit
candela per square metre	cd/m^2	luminance	
centi	c	prefix	$10^{-2} = 0.01$
centilitre	cL	capacity	0.01 L
centimetre	cm	length	0.01 m
coulomb	C	electric charge	A·s
cubic centimetre	cm^3	volume	1 cm^3 (volume) = 1 mL (capacity)
cubic metre	m^3	volume	1 m^3 (volume) = 1 kL (capacity)
cubic metre per mole	m^3/mol	molar volume	
cubic metre per second	m^3/s	volume flow rate	
day	d	time	24 h
deca	da	prefix	$10^1 = 10$
decalitre	daL	capacity	10 L
decametre	dam	length	10 m
deci	d	prefix	$10^{-1} = 0.1$
decilitre	dL	capacity	0.1 L
degree Celsius	°C	temperature	
degree (of arc)	°	angle	$180^\circ = \pi$ rad
farad	F	electric capacitance	C/V
giga	G	prefix	10^9
gram	g	mass	0.001 kg
gram per cubic centimetre	g/cm^3	density	1 g/cm^3 = 1 000 kg/m^3
gram per millilitre	g/mL	density	1 g/mL = 1 g/cm^3
hectare	ha	area	10 000 m^2
hecto	h	prefix	$10^2 = 100$
hectometre	hm	length	100 m
henry	H	inductance	Wb/A
hertz	Hz	frequency	$s^{-1} = \frac{1}{s}$

Name of Unit or Prefix	Symbol	Quantity	Practical Equivalent
hour	h	time	60 min
joule	J	energy	
joule per kilogram	J/kg	specific energy	
joule per kilogram kelvin	J/(kg·K)	specific heat capacity	
kelvin	K	temperature	base unit
kilo	k	prefix	$10^3 = 1\ 000$
kilogram	kg	mass	base unit
kilogram metre per second	kg·m/s	momentum	
kilogram per cubic metre	kg/m^3	density	g/L
kilohertz	kHz	frequency	1 000 Hz
kilolitre	kL	capacity	1 000 L
kilometre	km	length	1 000 m
kilometre per hour	km/h	speed	
kilonewton	kN	force	1 000 N
kilopascal	kPa	pressure	1 000 Pa
kilowatt	kW	power	1 000 W
litre	L	capacity	1 L (capacity) = 1 dm^3 (volume)
lumen	lm	luminous flux	cd·sr
lumen second	lm·s	quantity of light	
lux	lx	illuminance	lm/m^2
lux second	lx·s	light exposure	
mega	M	prefix	$10^6 = 1\ 000\ 000$
megagram	Mg	mass	1 000 000 g
metre	m	length	base unit
metre per second	m/s	speed, velocity	3.6 km/h
micro	μ	prefix	$10^{-6} = 0.000\ 001$
micrometre	μm	length	10^{-6} m
milli	m	prefix	$10^{-3} = 0.001$
millilitre	mL	capacity	0.001 L
millimetre	mm	length	0.001 m
minute	min	time	60 s
minute (of arc)	'	angle	$60' = 1^\circ$

Name of Unit or Prefix	Symbol	Quantity	Practical Equivalent
mole	mol	amount of substance	base unit
mole per litre	mol/L	concentration	
newton	N	force	$kg \cdot m/s^2$
newton metre	N·m	moment of force torque energy	1 J
ohm	Ω	electric resistance	V/A
pascal	Pa	pressure	N/m^2
pascal second	Pa·s	dynamic viscosity	
radian	rad	plane angle	π rad = 180°
radian per second	rad/s	angular velocity	$\frac{180^\circ}{\pi}$/s
revolution per minute	r/min	frequency	
revolution per second	r/s	frequency	
second	s	time	base unit
second (of arc)	"	angle	60" = 1'
siemens	S	electric conductance	A/V
square centimetre	cm^2	area	0.000 1 m^2
square metre	m^2	area	10 000 cm^2
square metre per second	m^2/s	kinematic viscosity	
steradian	sr	solid angle	
tesla	T	magnetic flux density	Wb/m^2 or N/A·m
tonne (metric ton)	t	mass	1 000 kg
volt	V	electric potential	W/A or J/C
volt per metre	V/m	electric field strength	N/C
watt	W	power	J/s
watt per metre kelvin	W/(m·K)	heat conductivity	
watt per square metre	W/m^2	heat flux density	
weber	Wb	magnetic flux	V·s or J/A
year (annum)	a	time	365.25 d

SUMMARY OF COMMONLY USED UNITS

Quantity	Unit	Symbol	Relationship
Length	kilometre	km	1 km = 1 000 m
	metre	m	1 m = 10 dm = 100 cm
	decimetre	dm	1 dm = 10 cm
	centimetre	cm	1 cm = 10 mm
	millimetre	mm	
Area	square kilometre	km^2	1 km^2 = 100 ha
	hectare	ha	1 ha = 10 000 m^2
	square metre	m^2	1 m^2 = 10 000 cm^2
	square centimetre	cm^2	
Volume	cubic metre	m^3	1 m^3 = 1 000 000 cm^3
	cubic centimetre	cm^3	
Capacity	kilolitre	kL	1 kL = 1 000 L
	litre	L	1 L = 1 000 mL
	millilitre	mL	
Concentration	mole per litre	mol/L	
	mole per cubic metre	mol/m^3	
Mass	megagram	Mg	1 Mg = 1 t
	tonne (metric ton)	t	1 t = 1 000 kg
	kilogram	kg	1 kg = 1 000 g
	gram	g	1 g = 1 000 mg
	milligram	mg	
Time	day	d	1 d = 24 h
	hour	h	1 h = 60 min
	minute	min	1 min = 60 s
	second	s	
Velocity (Speed)	metre per second	m/s	1 m/s = 3.6 km/h
	kilometre per hour	km/h	
Density	kilogram per cubic metre	kg/m^3	1 t/m^3 = 1 000 kg/m^3
	tonne per cubic metre	t/m^3	1 g/cm^3 = 1 000 kg/m^3
	gram per cubic centimetre	g/cm^3	
Density (of liquids)	kilogram per litre	kg/L	1 kg/L = 1 000 kg/m^3
	gram per millilitre	g/mL	1 g/mL = 1 000 kg/m^3

Quantity	Unit	Symbol	Relationship
Frequency	hertz	Hz	
Plane angle	radian	rad	$1\ \text{rad} = \frac{180^\circ}{\pi}$
	degree	°	$1^\circ = 60'$
	minute	'	$1' = 60''$
	second	"	
Amount of substance	mole	mol	
Electric current	ampere	A	
Electrical resistance	ohm	Ω	
Energy	joule	J	
Force	newton	N	
Potential difference	volt	V	
Pressure	pascal	Pa	
Temperature	degree Celsius	°C	

INTERRELATIONSHIPS

Excluding the mass of the container:

A cube 1 cm x 1 cm x 1 cm if filled with water at 4 °C holds 1 mL and has a mass of 1 g.

A cube 10 cm x 10 cm x 10 cm if filled with water at 4 °C holds 1 L and has a mass of 1 kg.

A cube 1 m x 1 m x 1 m if filled with water at 4 °C holds 1000 L and has a mass of 1 t.

NUMERIC DATING*

Numeric dating is simply a means of expressing the date by means of numbers. The year, month and day in descending order of magnitude are expressed with 8 digits: 4 for the year, 2 for the month and 2 for the day. For example, April 7, 1975 can be expressed as 1975 04 07 or 1975-04-07.

The logic of this technique of recording a date becomes apparent when one is looking up past records that are arranged chronologically. One would first search for the year, then the month and finally the day.

24-HOUR TIMEKEEPING SYSTEM**

Sequence-The sequence of time elements in the 24-hour timekeeping system shall be:

hour minute second (if required)

Separator-A colon shall be used as the separator between hour and minute, and between minute and second.

Note: The symbols h, min, and s are not used because they are the symbols for hour, minute and second in the sense of duration or length of time. Thus 14 h 30 min expresses a measured time duration of fourteen hours and thirty minutes; while 14:30 refers to the time of day, i.e., two hours and thirty minutes past noon; 14 h 30 is ambiguous and should therefore not be used.

The absence of any separator (i.e., writing 14:00 incorrectly as 1400 or 1400 h) may give rise to the misleading practice of referring to that time as "fourteen hundred hours". It is suggested that, in speech, 14:00 may be expressed as "fourteen", "fourteen hours", or "fourteen zero zero".

e.g.	Time	READ
	00:00	zero hour (instant of midnight, beginning of day)
	00:15	zero fifteen
	03:00	three hours
	16:30	sixteen thirty
	15:43	fifteen forty-three
	24:00	twenty four hours (instant of midnight, end of day)

Note: Numeric dating and the 24 hour timekeeping system are not part of SI but provided for general information.
When the figure 24 is used to represent the hour, it is never followed by any digits except zeros.

* The Metric Guide
Council of Ministers of Education
Second Edition
March, 1976

** National Standard of Canada
All-Numeric Dates and Times
CAN3-Z234.4-79